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Review of Noise Study
For
Record Hill Wind, LLC.

Submitted: February 18, 2009

On Behalf of:
The People's Task Force on Wind Power
(Formerly: Concerned Citizens to Save Roxbury)

1 Introduction

1.0 Thank you for permitting me to submit my review of the noise studies for the Record Hill Wind Project proposed by Record Hill Wind, LLC (RHW). This review was conducted at the request of and on behalf of The People's Task Force on Wind Power.

1.0.1 My name is Richard R. James. I am the Owner and Principal Consultant for E-Coustic Solutions, of Okemos, Michigan, USA. I have been a practicing acoustical engineer for over 35 years.

1.0.2 I obtained my Bachelor's Degree in Mechanical Engineering in 1971 in the sub-category of applied acoustical engineering. I am a Full Member of the Institute of Noise Control Engineers. I first joined the Institute in 1973, shortly after its formation and have been engaged in the field of acoustical engineering for my entire career.

1.0.3 I have attached a narrative of my career experience as it relates to the topic of this report as Appendix A.

1.0.3.1 During my career, I have been especially interested in the application of computers for modeling sound propagation, such as is commonly done when addressing community noise for new and existing industrial and commercial facilities. My undergraduate thesis in 1971 was on this topic and my company was one of the first to program, validate, and use computer models to predict sound propagation in 1974. This model and its results were accepted in Hearings on Occupational Noise Exposure held by the US DOL in 1976.

1.0.3.2 I have also pursued my interest in the practical aspects of standardizing acoustical measurement procedures used when assessing the compatibility of a new industrial facility or process and the existing land-use of the community that would be affected by the facility or process. My interest in standardization of acoustical measurement procedures has also been applied to acoustical engineering tests for worker noise exposure and the purchasing of new and rebuilt industrial machines for use both inside and outside industrial facilities for many Fortune 100 companies.

1.0.3.3 The combination of these two interests, computer modeling and measurement procedures leads to their application in evaluating the impact that sound emissions from industrial machines will have on the adjacent communities. My consulting experience in this field of interest ranges from relatively simple cases of complaints about community noise to complex issues concerning, for example, complex

automotive manufacturing sites for US automobile manufacturers in the USA, Canada, and Europe.

1.0.4 As part of my research into wind turbine sound emissions and the effect of those sounds on the host community, I prepared a manuscript, in collaboration with Mr. George Kamperman, titled the "*'How to' Guide to Siting Wind Turbines to Prevent Health Risks from Sound.*"
This paper is available at: http://www.windaction.org/documents/17229

2 Important Documents

2.0 In preparation for this report the following documents were reviewed:

2.0.1 "Sound Level Assessment" prepared by RSE for Record Hill Wind, LLC. Dated: Dec. 2008

2.0.2 Maine Department of Environmental Protection's Chapter 375 rules: "No Adverse Environmental Effect Standard of the Site Location Law," Section 10. Control of Noise, and related sub-sections.

2.0.3 "Maine State Planning Offices' Technical Assistance Bulletin #4, Noise, May 2000.

2.0.4 Department of Environmental Protection's "Compliance Policy," June 1, 1997

2.0.5 Communications between Mr. Andrew Fisk, Bureau Director BLWQ and Mr. David Little, Commissioner, Jan. 10, 2008, re: DEP standards on noise and shadow flicker at wind power projects. This document is available to the public on Maine's Task Force web site.

3 Review of "Sound Level Assessment" Report.

3.0.1 This report purports to provide the information needed to assess the impact of the proposed wind project as required by the rules of Maine's Chapter 375, part 10, *Control of Noise*. It is presented in six sections:

- Applicable DEP sound level limits
- A description of the wind project and land uses in the project vicinity,
- Existing sound levels,
- Sound level estimates for RHW operations, and
- A comparison of expected future sound levels with existing sound levels.

This testimony will not attempt to detail all of the problems this reviewer identified in the study methodology or conclusions, but will instead focus on several examples of these problems that demonstrate why the study should be rejected[1]. .

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[1] This written testimony is intended to supplement and support the oral presentation on noise by Mr. Steven Thurston, a property owner on the west side of Record Hill, at the hearing on February 18, 2008. His oral and written testimony also covers similar topics. However, it is expressed in his own language and with graphics that illustrate his points. Mr. Thurston's testimony and exhibits were prepared in conjunction with this reviewer's assistance and supervision. The combination of this written testimony and Mr. Thurston oral testimony will show that the RHW sound study and its conclusions are not appropriate for determining whether the RHW project meets MDEP noise criteria or whether the project will be compatible with the community, especially at the south end and west of the ridge on the shores of Roxbury Pond

3.1 Applicable DEP sound level limits

3.1.1 Section 3.1 of the *Sound Level Assessment* report for RHW focuses on the Maine DEP sound level limits in Chapter 375 part 10, Control of Noise providing a narrative summary, a table of criteria and limits, and a list of exempt activities.

The section is an accurate representation of the rules, with one important exception. In the narrative on *Short Duration Repetitive and Tonal Sounds* at the bottom of page 4 the criteria for whether a sound qualifies as a Short Duration Repetitive Sound (SDRS) or not fails to mention that the instrument conducting the test must be set to use the 'fast' response setting to determine the maximum or "L_{max}" sound pressure level. This is an important omission since the 'fast' response setting is not used for any other DEC criteria. The requirement for 'fast' response is designed to make this test very sensitive to fluctuating or impulsive sounds. The other rules use one -hour averages (L_{eq}) that are insensitive to short term fluctuating sounds. The DEP definition is:

> (19)SHORT DURATION REPETITIVE SOUNDS: A sequence of repetitive sounds which occur more than once within an hour, each clearly discernible as an event and causing an increase in the sound level of at least 6 dBA on the fast meter response above the sound level observed immediately before and after the event, each typically less than ten seconds in duration, and which are inherent to the process or operation of the development and are foreseeable.

At another point the rules state:

> NOTE: **The maximum sound level of the short duration repetitive sound shall be measured using the fast response [L_{AFmax}]**

This is a significant omission since later in the RHW report at 7.4, page 32, the report states that:

> "7.4 Tonal and Short Duration Repetitive Sound
>
> {first paragraph omitted}
>
> "Short duration repetitive (SDR) sounds are a sequence of sound events each clearly discernible that causes an increase of 6 dBA or more in the sound level observed before and after the event. SDR sound events are typically less than 10 seconds in duration and occur more than once within an hour. Published studies of noise from wind turbine operations indicate that sound levels can fluctuate over brief periods as noted by the passage of wind turbine blades and typically range from 2 to 4 dBA. Consequently, RHW operations are not expected to result in the 6 dBA increase required to be SDR sounds as set forth in DEP 375.10."

The reference for this assertion that wind turbine sound fluctuation are only 2-4 dB is from the 1997 version of the British wind siting standard ETSU-R- 97. This standard is now over 10 years old and based on outdated information more relevant to the smaller turbines common 10-15 years ago than today's modern upwind industrial scale machines. Its use in the U.K. over the past 11 years has resulted in problematic wind utility projects, especially those involving the larger wind turbine

models, where the adjacent property owners are exposed to sound levels similar to the conditions at Mars Hill.

This standard is now being considered for review since its use has led to a significant number of wind projects that result in complaints of SDRS (also called amplitude modulation in the U.K.) and low frequency noise problems inside homes within 1 to 2 km from the wind project. Why is only this reference cited? There are many other research studies that show that SDRS sounds from wind turbines (described as "whooshing" or "thumping") are commonly in the range of 5-6 dBA (L_{Afast}) and can frequently exceed 10-15 dBA during night time weather conditions that are often present in the summer, after sunset, as well as, at other times and seasons.

The RHW study claims that SDRS will not be a problem for the residents at the foot of Record Hill. Yet, the work of numerous acoustical engineers (including the author of this testimony) and independent researchers such as Dr. Fritz Van den Berg and Dr. Eja Pederson, the authors of the *WindFarm Perception* study conducted in the EU by a major medical university and published in summer of 2008 shows SDRS is both common at the 5-6 dB level and can be 10-15 dB over the limits of the MDEP's SDRS rules on some of those days or nights. The claim in the RHW study Section 7.4 that the proposed wind farm will not exhibit this noise and warrant the application of the 5 dB penalty is unfounded and appears to be an example of cherry picked research to support a client's goals that ignores more recent and more independent published research. Since literature supports the case for exceedances of the SDRS rules and the computer model used to estimate post-construction sound levels only reports average sound levels, not at all equivalent to the readings that would be obtained with the 'Fast' meter setting, the appropriate conclusion for the RHW study is that the 5 dB penalty should be applied to the final decisions about the project's compliance with MDEP rules.

In a letter from Mr. Andrew Fisk, Director of BLWQ to Mr Littel, Commissioner it is noted by Mr. Fisk that "Noise generated from wind turbines does have attributes that warrant particular focus in the review of projects, including the low frequency modulating noises generated as turbine blades pass by towers." It is clear that the RHW study did not make SDR sounds the "particular focus in the review of projects..." as Mr. Fisk suggests. Instead, they used a 10 year old British standard to claim that no attention was warranted.

3.1.2 Pre-construction Sound Measurements

One primary purpose in assessing the community sound levels as part of the application process is to determine the conditions and times of the day/night when the new noise source will be most clearly audible to people at the foot of the ridge. New noise sources are properly assessed for annoyance and sleep disturbance potential by comparing the sound levels during the quietest times of the day or night when the new noise source may be operating and 'most clearly audible' to people. Since wind turbines can operate day and night, Monday through Sunday, every day of the year it is clear that the critical times for noise disturbance is the night time after

community activities stop and only the sounds of nature are present. Since wind turbines are ridge mounted there will be many nights when they operate at full power and yet there will be little or no wind in the valley below to mask the wind turbine sound. The MDEP rules imply that for rural communities, even those as sheltered as Roxbury Pond, the nighttime sound levels are 35 dBA and thus assume that the nighttime limit should be 45 dBA.

Nighttime sound levels of the background ambient taken by this reviewer along the foot of ridges in the Allegany mountains with communities like the Roxbury pond area at their foot were routinely in the range of 18-25 dBA. The tests conducted for the RHW study were conducted over days and nights, during rain, thunderstorms and windy weather. These are clearly not the conditions where the wind turbines would be clearly audible. These are the conditions of least audibility and are not appropriate for assessing sleep disturbance potential or other quiet times in the community.

It is this reviewers opinion that the background ambient sounds levels obtained by the RHW study methodology are contaminated with artifacts that make the data unsuitable for use in assessing the communities quiet times and overstate the pre-construction sound levels, especially at night by 5 to 15 dB. A review of the summary Tables 6-1 to 6-3 and the graphs in Appendix II of sound levels vs. time of day show that there are some periods, typically at night, where measurement reveals the true nature of Roxbury's "background ambient." The results in the tables for night time sound levels of 26 dBA or so are closer to the sound levels that this reviewer would expect from his own tests during the sensitive nighttime periods where sleep disturbance is most likely to occur. It is these one hour segments of the long test samples that should have been used to establish the pre-construction background ambient since they are the times when the turbines will be most clearly audible.

The oral testimony by Mr. Thurston also addresses this issue, but, from the point of view of a person who has considerable personal experience with the soundscape of Roxbury Pond both during the day and night time. His observations are in general agreement with my position on the validity and utility of the measurements reported in the RHW sound study. Mr. Thurston will also apply the principles provided in the Maine State Planning Offices' *Technical Assistance Bulletin #4* to illustrate how the introduction of a wind project into the quiet community will lead to complaints and potentially to demands to terminate operation of the wind project if there are not mitigating options available to RHW.

3.1.3 Computer model estimates of operational sound level.

Section 7 of the RHW study explains how a computer model was programmed to provide estimates of the operational sound levels of the wind project around the ridge top and into the community at the foot of the ridge. These results are provided in the form of a contour map (Figure 7-4) showing estimated sound levels as iso-bars. This figure shows that the RHW study estimates the operational sound levels west of

the ridge at Roxbury Pond to be between 35 dBA and 40 dBA. The homes at the south end of the ridge near Partridge Peak (represented by PL5 and RH3) are represented as having 43 dBA at the property line but suddenly drop 5 dB to 38 dBA in the short distance between the property line and the home at RH3. This sharp drop is not explained in the study, but when looking at the contours on the east and west sides the distances required for the same 5 dB drop are much greater than for the south end.

Analysis of the topography performed by Mr. Thurston show that the turbines at both sites are in clear view and not blocked by the ridge. Thus, it is quite possible that the programming of the model is not correct for the topography of the ridge, at least at the south end.

However, these anomalies are not the primary deficiency of the model used for RHW. Inspection of the contours representing sound propagation from the turbines to the properties adjacent the project show that the model assumed that the sound levels from the turbines to the receiving locations decay at the rate of 6 dB per doubling of distance. Thus, the model shows that the operational sound levels of the turbines comply with the MDEP rules for nighttime noise at Roxbury Pond and the south end homes.

This is reinforced in the narrative of the RHW study where on page 38 it states: "For every doubling of distance from a stationary hemispherical noise source, the sound level drops by 6 dB. Thus if the sound level is 50 dBA at 500 feet, the sound level at 1000 feet will be 44 dBA, and will be 38 dBA at 2000 feet."

But, this is not the appropriate decay rate for sound from ridge mounted turbines. The appropriate decay rate for ridge mounted turbines is 3 dB per doubling of distance until the receiver locations are about a mile or two away from the ridge.

This has been known as far back as 1990 when a research project conducted for NASA studies wind turbine sound propagation. The graph below (Figure 1) shows the NASA study's graphic illustrating where models should use the 3 dB decay rate and the 6 dB decay rate. The RHW study is in error in its construction and this error will lead to underestimates of the sound levels in the areas around the wind project.

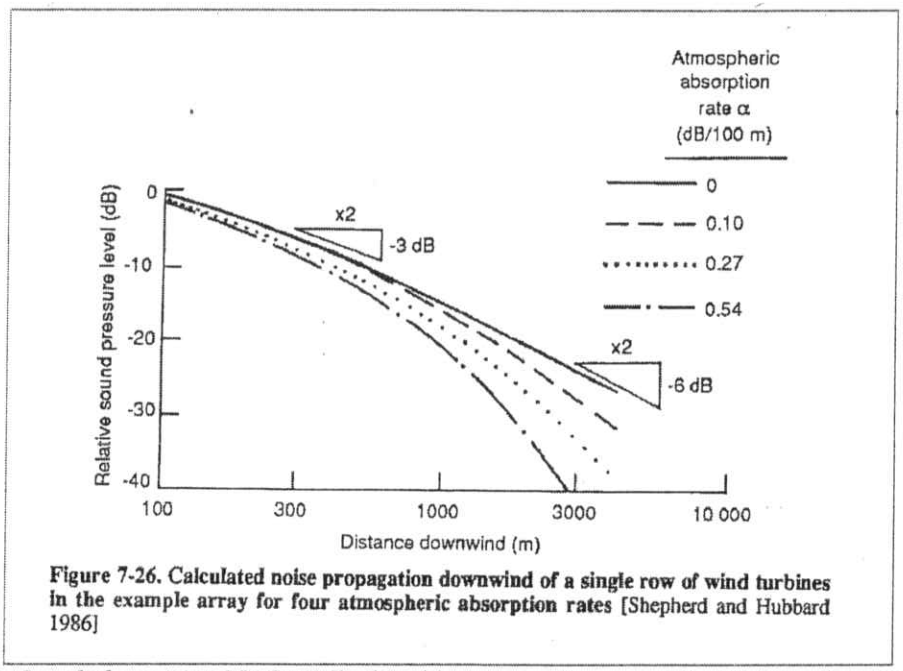

Figure 7-26. Calculated noise propagation downwind of a single row of wind turbines in the example array for four atmospheric absorption rates [Shepherd and Hubbard 1986]

Figure 1-Graph from 1990 NASA Wind turbine Acoustics report by Hubbard and Sheperd showing that the sound from ridge mounted turbines propagates at 3 dB per doubling of distance and that the rate of 6 dB per doubling of distance does not occur until a mile or more from the ridge top.

The degree of this error is considerable. The RHW figure showing the sound levels as contours has three major lines. One bold green line for 55 dBA impacts, a bold blue line for 45 dBA and a third bold green line for 35 dBA. If the proper decay rate was applied by this model the sound level at the 45 dBA line would be 50 dBA or higher. The 35 dBA line that extends into Roxbury Pond would be 45 dBA. Thus, the results of a model based on well understood rules for how sound propagates from ridge mounted wind turbines severely under predict the impact of the project on the community. The model should have shown the sound levels along the west side of the ridge near Roxbury Pond as exceeding the MDEP nighttime limits of 45 dBA and at the homes near the south end the sound levels would be similarly higher than permitted at night under the MDEP rules.

Thus, the conclusions of the RHW study that the project meets the MDEP criteria are not supported by the findings of this review. It is only because of egregious errors in model construction and its underlying assumptions that the study could conclude otherwise.

The oral testimony by Mr. Thurston will present more information on this error and also present graphic exhibits showing the corrected contours for the west and south end of the Record Hill project.

4 Opinion of Reviewer

It is clear that this study is seriously flawed and its conclusions based on improper understanding of:

- Appropriate measurement procedures for assessing the period of greatest impact on the community, when the turbines are most clearly audible at night.

- The common occurrence of fluctuating short term sounds that exceed the 6 dB limit that should require application of the 5 dB penalty for SDRS from blade whoosh and thumps during the application phase, and
- A model that is improperly programmed resulting in it underestimating the sound levels in the community by 10 dBA or more at nearby homes.

One might ask if there is a way to demonstrate the seriousness of these errors and their consequences for the homes and properties near RHW likely to be exposed to sound levels in excess of MDEP rules. In response to this, it is only necessary to look to the Mars Hill project where the people living at its base were assured that sound levels would not be audible to them during day or night and that the sound levels would meet the MDEP criteria.

The result of the yearlong study of the operating Mars Hill wind project shows that the actual sound levels at the properties that were projected to be less than 45 dBA are subjected to measured sound levels of 52 dBA or more on a frequent basis.

It should be noted that the Mars Hill pre-construction studies were performed by the same consultants that conducted the study for Record Hill. They used the same methods for assessing background ambient sound levels, assumed that there would be no SDRS that exceeded 6 dB on the fast meter setting, and used 6 dB decay rates for their models. The measured operation sound levels of 52 dBA at the properties along the west side of Mars Hill is very close to the estimated sound levels at a similar distance for RHW if the 3 dB decay rate is used in model programming. This should be reason enough to reject the RHW study. If necessary the project should be put on hold until a proper study can be conducted using appropriate methods and procedures.

5 Recommendations

5.0 The first recommendation is that the existing sound study for RHW submitted in connection with the project be deemed deficient, flawed, and not suitable for evaluation of this project. These studies should be redone by qualified and independent acoustical consultants who have no stake in the outcome of the studies and who will follow ANSI/ASA/ISO procedures when conducting the studies.

5.1 If the project is permitted to proceed, it must be subject to the condition that the wind turbines that will be installed represent the state of the art in quiet operation. This decision on what turbines are installed must be subject to oversight by the community, and its experts. These 'quiet specification' wind turbines must be purchased with the necessary control circuits and remote monitoring systems to permit automatic control of the turbines to limit noise emissions as conditions warrant. They should be initially programmed to meet the criteria for not exceeding nighttime quiet background ambient levels of 25 or 30 dBA plus 5 dB at the nearest homes (to the south and west of the project). The purpose of these controls would be to limit sound emissions during the night and other times when the community is quiet. They will also allow for post construction mitigation of noise through control of the wind turbines' operation should complaints arise in the future.

6 This concludes my review on behalf of The People's Task Force on Wind Power. Thank you for the opportunity to present my understanding of the issues I have addressed, my opinions and recommendations.

Richard R. James, INCE
For: E-Coustic Solutions

Richard R. James

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